WE CLAIM:

1. A film deposition station for depositing a film onto a substrate comprising, a first part and a second part for accommodating a semiconductor substrate between them, the first part and the second part positioned opposite each other and parallel to the substrate upon retention of the substrate between the first and second parts, wherein the first part and the second part are configured to be spaced less than about 2 mm from a major surface of a substrate accommodated between them, wherein at least one of the parts is provided with a heater for heating that part, and wherein each part is provided with a set of gas supply channels connected to a source of gas, wherein the source of gas for the first part is configured to supply mutually reactive reactants in a sequence of alternating, separated pulses for atomic layer deposition (ALD).

2. The film deposition station of Claim 1, wherein each set of gas supply channels comprises a plurality of horizontal gas dispersion channels connected to a plurality of vertical gas injection channels, the plurality of horizontal gas dispersion channels providing gas to the plurality of vertical gas injection channels, wherein the plurality of vertical gas injection channels are configured to discharge gas onto a major surface of the substrate.

3. The film deposition station of Claim 2, wherein the horizontal gas dispersion channels have a larger cross-sectional area than the vertical gas injection channels.

4. The film deposition station of Claim 3, wherein the horizontal gas dispersion channels each have a diameter of about 3-5 mm and the vertical gas injection channels each have a diameter of about 1-3 mm.

5. The film deposition station of Claim 2, wherein the vertical gas injection channels each comprise a first and a second section, wherein the first section opens to one of the plurality of horizontal gas dispersion channels and has a larger cross-sectional area than the second section, wherein the second section opens to a space for accommodating the substrate.

6. The film deposition station of Claim 2, wherein the vertical gas injection channels are positioned to extend uniformly across an entire major surface of the substrate.

7. The film deposition station of Claim 2, wherein the horizontal gas dispersion channels extend radially across an interior of the first and the second parts.

8. The film deposition station of Claim 1, wherein the mutually reactive reactants are supplied through the first part, wherein the first part comprises a set of separated gas supply channels for each reactant, wherein the sets of separated gas supply channels are vertically and horizontally displaced relative to one another.

9. The film deposition station of Claim 1, wherein the gas supply channels are configured to discharge gas to fully support the substrate between the first part and the second part.

10. The film deposition station of Claim 1, wherein one of the parts is configured to be at a higher temperature than the other one of the parts, wherein the film deposition station is configured to supply the reactants in alternating, separated pulses from the one of the parts that is at a higher temperature.

11. The film deposition station of Claim 1, wherein one of the parts is configured to be at a lower temperature than the other one of the parts, wherein the film deposition station is configured to supply the reactants in alternating, separated pulses from the one of the parts that is at a lower temperature.

12. The film deposition station of Claim 1, wherein the first part and the second part are configured to be spaced less than about 1 mm from a major surface of a substrate.

13. The film deposition station of Claim 12, wherein the first part and the second part are configured to be spaced less than about 0.5 mm from a major surface of a substrate.

14. The film deposition station of Claim 1, wherein the gas supply channels are configured to cause rotation of the substrate.

15. A reactor for semiconductor processing, comprising:

an upper reactor block and a lower reactor block for accommodating a semiconductor substrate therebetween,

wherein the upper and the lower reactor blocks are configured to be less than about 2 mm from a major surface of the substrate when the substrate is retained therebetween, and wherein the reactor is configured to discharge mutually reactive reactants from at least one of the reactor blocks to the substrate in sequential

alternating, separated pulses, wherein the at least one of the reactor blocks comprises a set of gas channels configured to transport and discharge the sequential alternating separated pulses of reactant to the substrate.

16. The reactor of Claim 15, wherein the upper and the lower reactor blocks are configured to be heated to temperatures at which condensation or decomposition of the mutually reactive reactants is substantially prevented.

17. The reactor of Claim 16, wherein the upper and lower reactor blocks are configured to be heated to different temperatures.

18. The reactor of Claim 17, wherein the upper and the lower reactor blocks are configured to heat the substrate to a different temperature during each pulse.

19. The reactor of Claim 15, wherein the lower block is vertically movable relative to the upper block to allow for decreasing and increasing the distance between the substrate and the reactor blocks for loading and unloading of the substrate.

20. The reactor of Claim 15, wherein the upper block is configured to be at a lower temperature than the lower block, further comprising a removable shield attached to the lower block, wherein the reactor is configured to concentrate deposition of the at least two mutually reactive reactants on the removable shield relative to other surfaces of the reactor.

21. The reactor of Claim 20, wherein the removable heat shield is configured to be heated to the same temperature as the lower block.

22. The reactor of Claim 15, wherein the upper and the lower reactor blocks are configured to be less than about 1 mm from a major surface of the substrate.

23. A method of depositing a layer on a semiconductor substrate, comprising:

providing an apparatus having a first side section and a second side section located opposite one another, the side sections each having facing planar surfaces, wherein at least one of the side sections is heated to a temperature higher than about 200°C;

placing the substrate in the apparatus between the first and second side sections; and

applying two gas streams, in opposing directions, from the first and second side sections to two opposing planar sides of the semiconductor substrate, wherein a spacing between each of the first and second side sections and the semiconductor substrate is at most about 2 mm, wherein the facing planar surfaces of the side sections extend completely across the opposing planar sides of the semiconductor substrate,

wherein at least one of the gas streams provides different reactants in a sequence of alternating, separated pulses for an atomic layer deposition (ALD) process.

24. The method of Claim 23, further comprising, after placing the semiconductor substrate between the side sections, moving the side sections closer to one another until the spacing between each of the side sections and the substrate is no more than about 2 mm.

25. The method of Claim 24, wherein one side section is at a first temperature and the other side section is at a second temperature.

26. The method of Claim 25, further comprising periodically changing at least one of the gas streams so that the substrate temperature is periodically switched between a first and a second substrate temperature, wherein a frequency for switching the substrate temperature substantially coincides with a frequency for alternating the reactants.

27. The method of Claim 26, further comprising switching the relative distance of the substrate to each of the first and the second side sections to switch between the first and the second substrate temperature.

28. The method of Claim 26, wherein the substrate is at the first temperature during supplying of a first reactant and wherein the substrate temperature is switched to the second substrate temperature and switched back to the first temperature again before supplying the first reactant in a next pulse.

29. The method of Claim 23, wherein a first gas is discharged from the first side section and a second gas is discharged from the second side section, wherein the second gas has thermal conduction properties different from those of the first gas.

30. The method of Claim 23, further comprising changing the composition of one of the gas streams.

31. The method of Claim 30, wherein changing the composition of one of the gas streams alters the temperature of the substrate.

32. The method of Claim 23, further comprising changing the flow of one of the gas streams to change a position of the substrate.

33. The method of Claim 23, wherein the side sections are massive relative to the substrate, wherein the side sections have sufficient heat capacity so that, when heated, heat is transferred to an unheated substrate loaded between the side sections with a negligible decrease in temperature of the side sections.

34. The method of Claim 23, further comprising cooling the substrate before removing the substrate from between the first and the second side sections.

35. The method of Claim 23, wherein applying two gas streams causes rotation of the substrate.

36. The method of Claim 23, wherein applying two gas streams suspends the substrate between the first and the second side sections without any mechanical support.

37. A method for semiconductor processing, comprising:

providing a processing apparatus having a first and a second reactor block;

positioning a substrate between the first and the second reactor blocks, wherein the substrate is less than about 2 mm from each of the first and the second reactor blocks after positioning;

discharging, from the first reactor block, mutually reactive reactants in alternating, temporally separated pulses onto the substrate; and

heating the substrate using the first or second reactor block to one or more desired substrate temperatures, wherein the first reactor block is set at a first temperature at which condensation or decomposition of the mutually reactive reactants is substantially prevented.

38. The method of Claim 37, wherein heating the substrate comprises setting the second reactor block at a second temperature.

39. The method of Claim 38, wherein the first temperature and the second temperature are outside of a temperature window in which optimal atomic layer deposition rates of the reactants being discharged occur.

40. The method of Claim 39, wherein the first temperature and the second temperature are different.

41. The method of Claim 40, wherein the first temperature and the second temperature differ by about 100°C or more.

42. The method of Claim 41, wherein the first temperature and the second temperature differ by about 200°C or more.

43. The method of Claim 37, wherein the first block is actively heated and the second block is actively cooled.

44. The method of Claim 37, wherein at least one of the mutually reactive reactants self-limitingly adsorbs on the substrate.

45. The method of Claim 37, wherein discharging mutually reactive reactants in alternating, temporally separated pulses comprises flowing each of the two mutually reactive reactants through separate sets of gas channels at different times.

46. The method of Claim 45, further comprising continuously flowing an inert gas through each separate set of gas channels.

47. The method of Claim 46, wherein the inert gas is nitrogen gas.

48. The method of Claim 37, wherein discharging mutually rèactive reactants is performed with the apparatus operated at atmospheric pressure.

49. A method for semiconductor processing, comprising:

loading a substrate in a reaction chamber;

completely supporting the substrate on a gas cushion in the chamber; and

directing mutually reactive reactants in alternating, temporally separated pulses onto a major surface of the substrate while completely supporting the substrate on the gas cushion.

50. The method of Claim 49, wherein supporting the substrate comprises generating a gas cushion on each major side of the substrate.

51. The method of Claim 49, wherein the reaction chamber comprises two reactor blocks, wherein one reactor block is configured to be on one side of the substrate and the other reactor block is configured to be on an opposite side of the substrate, wherein each reactor block is positioning about 1 mm or less from the substrate after loading.

52. The method of Claim 51, wherein directing mutually reactive reactants comprises discharging all the mutually reactive reactants from the same reactor block.

53. The method of Claim 49, wherein a time from directing one reactant onto the major surface to directing the one reactant to the major surface again constitutes a deposition cycle, wherein about a monolayer or less of reactant is deposited on the substrate per deposition cycle.

54. The method of Claim 49, wherein directing mutually reactive reactants comprises maintaining and flowing the reactant in separate channels before discharging the reactants onto a major surface of the substrate.

55. A film deposition station for depositing a film onto a substrate, comprising:

a first part and a second part for accommodating a semiconductor substrate between them, the first part and the second part positioned opposite each other and parallel to the substrate upon retention of the substrate between the first and second parts, wherein the first part is provided with a first set of gas supply channels connected to a source for a first reactant and a second set of gas supply channels connected to a source for a second reactant, wherein the first and second set of gas supply channels are configured to keep the reactants separated until discharging the reactants out from the gas supply channels to the substrate, wherein the first and the second reactant are mutually reactive; and

controls to supply the first and the second reactant from the source for a first reactant and from the source for a second reactant in sequential alternating separated pulses for atomic layer deposition (ALD).

56. The film deposition station of Claim 55, wherein at least one of the parts is provided with a heater.

57. The film deposition station of Claim 55, wherein each set of gas supply channels comprises a plurality of horizontal gas dispersion channels connected to a plurality of vertical gas injection channels, the plurality of horizontal gas dispersion channels providing gas to the plurality of vertical gas injection channels, wherein the plurality of vertical gas injection channels are configured to discharge gas onto a major surface of the substrate.

58. The film deposition station of Claim 57, wherein the horizontal gas dispersion channels for one set of gas supply channels are horizontally displaced relative to the horizontal gas dispersion channels for the other set.

59. The film deposition station of Claim 57, wherein the horizontal gas dispersion channels for one set of gas supply channels are vertically displaced relative to the horizontal gas dispersion channels for the other set.

60. The film deposition station of Claim 55, wherein the second part is provided with a set of gas supply channels to discharge gas onto a second major surface of the substrate, opposite to the major surface.

61. The film deposition station of Claim 55, wherein the first and the second part are configured to be spaced less than about 2 mm from a major surface of the substrate accommodated between them.